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FLASH TALKS SESSION 2

KEYNOTE LECTURES

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Music and speech: Two facets of auditory cognition and their interplay

During past decades, our knowledge about the brain functions and structures underlying music perception, performance, and emotions has accumulated relatively quickly. However, much less is known about the brain determinants underlying music learning and music rehabilitation. The lack of systematic knowledge is particularly obvious when we consider the interaction between music and language functions. In my contribution, I will illuminate the effects of music learning on brain functions in childhood and adolescence. In this context, also the transfer effects of music in other domains of cognitive development will be discussed. Furthermore, I will show results from studies of music rehabilitation obtained from neurological patients. Taken together, these data indicate that music can be learnt across the whole life span, and, further, that it can be used to facilitate some transfer effects in development as well as enrich neurorehabilitation in a highly versatile manner.

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Fuzzy nonnative lexical representations

While it is widely recognized that, on average, second language (L2) speakers know fewer words than native (L1) speakers, the actual properties of L2 lexical representations are still insufficiently understood. The memory-based approaches argue that L2 speakers rely on a different kind of memory unique to L2 for storage and access of L2 words (Jiang & Forster, 2001; Qiao & Forster; 2017; Witzel & Forster, 2012). The episodic L2 hypothesis (Jiang & Forster, 2001) identifies episodic memory as the only type of memory operating in L2 lexical processing. This reliance only on episodic representations of L2 words is in contrast with L1 lexical processing that relies on the complementary learning systems, episodic and lexical/semantic (Lindsay & Gaskell, 2010).

According to the fuzzy representations-based hypothesis (Gor, under review), less familiar L2 words, either newly acquired or stored in long-term memory, are not robustly encoded: they are characterized by fuzzy forms, meanings, and form-meaning mappings. In this talk, I will review several pieces of evidence in support of fuzzy L2 lexical representations (Bordag, Kirschenbaum, Rogahn, Opitz, & Tschirner, 2017; Cook, Pandža, Lancaster, & Gor, 2016; Gor & Cook, 2020) and discuss the implications of fuzziness for different aspects of word recognition: lexical competition and lexical confusions leading to the retrieval of incorrect lexical items.

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Language pathways: The role of white-matter tracts in language processing

Cognitive processes are traditionally referred to as higher cortical functions, stressing the central role of cerebral cortex in cognition.

However, modern neuroscience considers cognition as of a dynamic, interactive and multimodal nature, relying on a distributed network of both cortical and subcortical brain regions. An apt example is language: white-matter connections are exactly what makes linguistic processing interactive, regarding both an interplay among different aspects of language and its communication with other, non-linguistic, cognitive functions. I will present a recent evidence on such cross-domain interactive nature of language processing and the pivotal role of white-matter tracts in it. These are data obtained using tractography imaging and direct electrical stimulation during awake craniotomies in tumor patients and voxel-based lesion-symptom mapping analysis in individuals with stroke.

SLIDE SESSION 1

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(Non)existence of zero morpheme: ERP evidence

One of the fundamental purposes of linguistics inquiry is to inform theories of syntax by studying the underlying neurocognitive processes. However, there is little agreement regarding the inventory and the universal nature of the building blocks that together constitute syntactic knowledge. One of the most controversial syntactic elements is the so-called zero morpheme. It was proposed in order to maintain a universalist syntax account across different languages. This constituent has no phonological representation (cf. "he brings" vs. "we bring_"), it only has an abstract meaning, and its main role has been described purely theoretically. One important question is whether zero morphemes are indeed represented, stored, and processed by the cognitive system.

To investigate the nature of this constituent and understand how processing of zero morphemes differs from that of filled ones, we ran

an EEG experiment with passive audio presentation of stimuli and visual distraction. Experimental stimuli (in Russian language) included conditions with two pronouns (он, она) combined with past tense verb forms and the same verbs not preceded by pronouns. Conditions differed in verbal gender marking and included zero masculine verb marker (он поел_), as opposed to the overt feminine verb marker (она поела). The syntactical priming/preactivation hypothesis (Shtyrov et al., 2003) predicts brain response reduction for connected morphemes and larger responses for the unconnected morpheme (он поела*). This implies that a similar response reduction could be produced by a zero morpheme in congruent (он поел_) as opposed to both incongruent (она поел_*) combinations and unprimed single forms (поел).

Preliminary results suggest that zero morphemes are indeed activated by the respective pronoun, which leads to reduced responses for felicitous phrases as opposed to either single verbs or agreement violations (p = .018 and p = .024, respectively). Furthermore, access to zero morpheme violation requires a stronger activation than in the correct conditions (p = .001) but it does not reach the level of single verb activation due to additional difficulties in finding correct gender mappings that would support the syntactic priming theories instead of simple error detection. Thus, activation of a zero masculine verb marker can be primed similar to the overt feminine marker. These findings provide valuable information about existence of zero morpheme processing.

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Do clothes make the man? Transposed-letter effects with logos

Companies and products are identified by their brand names, typically written with a specific letter style, color, and design (i.e., logos). This graphical information offers a distinctive image that facilitates their

recognition. However, the uniqueness of logos may make brand names more vulnerable to misspelled counterfeits (e.g., *adadis* instead of *adidas*). While recent research has revealed some similarities between the identification of logos and common words (Pathak et al., 2019), it is still unknown to what degree graphical information modulates the ability to distinguish authentic from misspelled brand names. Understanding the underlying processes of logo identification will help us not only to discern whether a brand is taking advantage of the reputation of another one but also to develop a comprehensive theory of reading.

We examined whether the confusability at detecting misspelled brand names created by transposing two letters (e.g., *pespi*) is higher when embedded in the full logo than when presented in plain format (Experiment 1, N = 30) or when removing all graphical information other than typeface from the logo (Experiment 2, N = 80). Participants had to decide whether the presented item was an original or a misspelled brand name. The misspelled stimuli were created by either transposing or replacing two internal letters of popular brands (*pepsi: pespi* vs. *pergi*), allowing us to have a measure of the transposed-letter confusability effect.

Linear mixed-effects models showed a transposed-letter confusability effect in all formats. This transposed-letter was greater for misspelled full logos than for misspelled plain brand names (122 vs. 94 ms, respectively; interaction: p < .001), and also, although to a much lesser degree, when the logo only kept the typeface (132 vs. 122 ms; interaction: p = .002).

The distinctiveness of graphical information in logos has a deleterious side effect: logos are quite vulnerable to counterfeit via misspelling branding. From the theoretical point of view, our findings demonstrate that when we encounter a logo, we process not only its orthographic information, but also its graphical information. Moreover, our findings suggest that we do not accurately encode their specific details, since we see them frequently in exactly the same layout. These findings open new avenues to link cognitive psychology/neuroscience with neuromarketing.

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Handling two writing systems in the bilingual brain: ERP investigation

Phonological inconsistencies between the native (L1) and second (L2) alphabets have been shown to interfere with visual word recognition. Specifically, L2 words containing graphemes shared with L1 but decoded phonologically differently across scripts are named slower than those containing non-ambiguous, specific L2 graphemes. This ERP study aims to scrutinize the neurophysiological mechanisms underlying bi-alphabetic reading.

Brain's electrical signals were collected from 24 Russian-English biliterates during a reading-aloud task in which they were presented with familiar and novel words across 10 repetition blocks. There were three Script conditions: (1) L1 Cyrillic, (2) L2 Roman, and (3) an ambiguous condition with phonologically inconsistent graphemes shared by L1 and L2 alphabets, e.g. P [/r/ in L1 vs. /p/ in L2]).

Linear mixed-effects modelling on naming latencies revealed that novel words were named slower in ambiguous than in L2 and particularly than in L1, replicating previous findings. However, visual recognition of familiar stimuli was found less influenced by phonological inconsistencies, with words in ambiguous script named slower than in L1 but faster than in L2 script. ERP analysis showed a similar trend, as reflected in early (P200) and late (N400 ms) brain responses. For familiar words, a similar P200 amplitude increase was found for those presented either in L2 or ambiguous scripts in comparison to those in L1 script, indicating enhancement of word-form orthographic analysis for non-native stimuli, regardless of their phonological inconsistency. However, such early effect was found for novel words; the processing of these stimuli was influenced by the script only at a later stage, with higher N400 amplitudes for those in ambiguous than in L1 and L2 scripts, thus reflecting the increased effort in their processing. Familiar words showed a different pattern at this latency, with similar

N400 amplitudes for ambiguous and L1 scripts and more positive-going amplitudes for L2 words.

Overall, our results indicate that phonological inconsistencies across alphabets interfere with novel word encoding, making their processing particularly effortful. However, for non-native, familiar words, the access to well-established lexical representations seems to mitigate this effect, leading to a direct, whole-word reading strategy which does not require the serial application of competing L1-L2 decoding rules.

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Does color modulate masked identity priming? Evidence from lexical decision

Neural models of visual-word recognition assume that parameters such as letter-case or color rapidly vanish when mapping the visual input onto abstract letter/word units (Dehaene et al., 2005). Consistent with this view, a number of masked priming experiments have shown that the lowercase prime 'diet' and the uppercase prime 'DIET' are equally effective for the target word 'DIET'. This has been obtained both behaviorally and when measuring electrophysiological components associated to the initial mapping to orthographic and lexical-semantic representations (N250 and N400) (Vergara-Martínez et al., 2015). Critically, these experiments also showed a word/pseudoword dissociation: there was a processing disadvantage of case-mismatched pairs for pseudowords (e.g., geub-GEUB slower than GEUB-GEUB), thus suggesting that, for words, lexical feedback helps override the visual differences for mismatched-case identity pairs.

The present masked priming experiment was designed to scrutinize at what processing level the dissociation of case-mismatch for words and pseudowords occurs. Specifically, we examined whether the dissociation between words and pseudowords in masked identity priming can be

modulated by a lower-level perceptual element such as color (e.g., diet-DIET, diet-DIET).

We factorially manipulated prime-target color congruency (the chosen colors were green and red) and prime-target case congruency in identity pairs. Other than that, we employed the same materials/procedure as in the Vergara-Martínez et al. (2015) experiment.

Bayesian linear mixed effects models on the latency data showed a matched-case congruency advantage for pseudowords (b = -21; 95% credible interval [-33.0, -9.7]), but not for word targets (b = -3; 95% credible interval [-12.4, 7.4]) (lexicality*case interaction: b = 23; 95% credible interval [4.0, 42.2]), thus replicating earlier findings. Critically, prime-target color congruency did not modulate masked priming effects (i.e., all the corresponding 95% credible intervals contained zero).

Our findings favor the idea that masked priming effects in lexical decision involve the integration of abstract letter representations rather than the integration of low-level elements such as color.

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Contextual acquisition of novel words: Interactions with verbal abilities, motivation, ambiguity tolerance and neural dynamics

Since building up a comprehensive vocabulary is crucial for successful educational, social and professional lives, it is important to understand word acquisition as a complex multidimensional process. The present study aimed to investigate psychological factors and neurophysiological correlates of successful word learning.

30 healthy right-handed adults (Russian speakers, 18–35 y.o.) acquired 20 novel nouns contextually, through reading 5-sentence stories. After

that, EEG responses to novel words were recorded in a word reading task, and five tasks (recall, recognition, lexical decision, semantic definition and semantic matching) were used to assess the success of acquisition and to divide the sample into groups of more and less successful learners. Verbal abilities, motivation and ambiguity tolerance were measured by Amthauer's test, BIS/BAS scales and MSTAT-1, respectively. EEG was analysed for both event-related potentials (ERP) and alpha-band oscillatory dynamics. Factor analysis was applied to neurophysiological and psychological parameters to assess their impact on novel word learning.

Alpha rhythm amplitude, quartile variation (CQV) and long-range temporal correlation (LRTC) contributed to two factors, both of which significantly correlated with recognition task accuracy. This implies that higher attention concentration and excitation/inhibition balance were related to better recognition of novel words. Further, successful learners had larger amplitude of frontal P200 ERP (known to reflect attentional processes) than the less successful ones, also indicating that high achievers were more attentive to the materials. Second, factors reflecting persistence in reaching goals and logical conceptual thinking ability positively correlated with the accuracy of recall and both semantic tasks as well as general success score. Thus, these psychological features support the acquisition of both novel word forms and their meanings. Finally, semantic definition accuracy and general success score negatively correlated with the tolerance of ambiguity: more ambiguity-tolerant subjects were less successful in acquiring novel semantics.

Both psychological and neurophysiological variables interact with word acquisition success. Whereas neurophysiological variables appear to be more connected to the recognition of novel nouns, psychological features are also reflected in semantic tasks.

SLIDE SESSION 2

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Development of phonological and orthographic parafoveal processing during reading in Russian

Many studies have shown that adult readers are able to extract phonological and orthographic information from upcoming words in a sentence and this parafoveal processing facilitates reading (Rayner, 1975). However, children who are learning to read initially rely more on phonological information, whereas reliance on orthographic information develops later (Ziegler et al., 2014). Studies that investigated reading in children agreed that many eye movement parameters reached the adult level by the age of 11 years (Blythe, Joseph, 2011). In the present study, we investigate the developmental pattern of phonological and orthographic parafoveal processing in Russian speaking children and adults using the invisible boundary eye tracking method.

We have tested 44 young adults, 12 children of 8 years old, and 14 children of 11 years old (data collection is ongoing; we plan to test 50 participants in each group). As stimuli we have selected 60 target nouns embedded in simple sentences. All nouns have the length of 5 letters

and their average frequency is 32 ipm. For each target noun, 5 preview conditions are generated: identical (ID; pirog); pseudohomophone (PsH; pirok); control condition for pseudohomophone (Control.PsH; pirob); transposed-letter (TL; priog); control condition for transposed-letter (Control.TL; pleog). Target nouns are preceded by adjectives with an average length of 7 letters. An invisible boundary is placed behind the last letter of an adjective. Previews are displayed until the boundary is crossed by a saccade, and then immediately replaced by the target noun.

We expect that for 8-year-olds a TL condition will provoke longer fixations on the target word compared to ID. We do not expect any difference for the durations of the fixations on the target words preceded by PsH and ID. For 11-year-olds and adults, we expect the opposite results. We also assume that for all groups the control conditions will provoke longer fixations on the target word than the PsH and TL conditions.

Our preliminary results for adults show that ID and TL conditions do not differ much (mean first fixation duration is 216 ms, SD = 78, and 229 ms, SD = 80), whereas in the PsH condition mean first fixation duration is longer (240 ms, SD = 83). These results could indicate that Russian-speaking adults indeed rely more on orthographic than on phonological information during reading.

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Anodal tDCS over Broca's area improves learning of novel vocabulary

Transcranial direct current stimulation (tDCS) has in recent years become an established tool for studies of human neurocognitive functions.

These, among other things, have suggested facilitatory effects of tDCS on language processes both in healthy subjects and in patients with speech disorders. However, there has been no comprehensive assessment of the effects of tDCS of key language areas on word acquisition under different learning conditions. To address this, we used tDCS of Broca's and Wernicke's areas and assessed the effects of stimulation location and polarity on contextual acquisition of novel words learnt either in explicit encoding (EE) or fast mapping (FM) conditions.

We modulated stimulation settings (anodal, cathodal, sham/placebo), site (Broca/Wernicke) and learning type (FM/EE). Five groups (n = 32 each) of native Russian speakers (aged 18–35) received 15 minutes of anodal or cathodal tDCS over one of the areas or sham stimulation. After this, they were exposed to 20 novel words repeated 10 times each in a sentential context in combination with pictures of novel objects in an FM or EE mode. They were then asked to recall as many items as they could. We quantified the learning success as the number of correctly recalled phonemes for each newly learnt word. These accuracies were analysed using ANOVA by participants (F1) and by items (F2), and compared between conditions and groups using Mann–Whitney U-test.

Participants correctly recalled on average 49.58% of the new words after the learning task. While the analysis of accuracy did not show a fully significant main effect of the stimulation group ($F1(4.124) = 1.77$, $p = .138$; $F2(4.60) = 2.24$, $p = .076$), the total accuracy was significantly ($z = -2.419$, $U = 332.5$, $p = .015$) higher after anodal Broca's tDCS (56.11% ± SEM 3.2%) than after sham stimulation (43.62 ± 4.2%). Separate analyses of the two learning conditions indicated that accuracies were higher for Broca's anodal than for sham stimulation for both FM ($z = -2.098$, $U = 357$, $p = .036$) and EE ($z = -2.103$, $U = 357$, $p = .035$) conditions. The outcomes were on average better for EE than FM conditions (Broca's anodal tDCS: 59.1 > 53.1%; sham: 47.1 > 40.1%) but this difference did not reach significance. No significant effects of other site/polarity combinations on learning outcomes were found. We conclude that anodal tDCS over Broca's area significantly improves implicit and explicit learning of novel vocabulary.

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First dyslexic font in Russian: Evidence of efficiency and new questions

The visual representation of the text, in particular the font, is one of the most important factors for its successful processing. The first Cyrillic font, LexiaD, is designed to make working with text easier for people with reading disabilities (Alexeeva, Golovatyuk, 2019). In the study, the efficiency of the font was tested in several experiments on different age groups.

Two experiments were conducted using eye-tracking. The first involved third- and fourth-grade children with (n = 31) and without reading disorders (n = 25). Participants were presented with the Children version of the Russian Sentence Corpus while their eye movements were recorded. The corpus comprised 30 sentences which were randomly divided for each participant in two halves rendered 1) in LexiaD, 2) in PT Serif, a serif Cyrillic font that is claimed to be one of the best by experts. In the second experiment, it was decided to test adolescents as they have more reading experience and better eye movement control system. Besides, this time more familiar and common Arial was chosen as the competing font. Adolescents in ninth and tenth grades with (n = 34) and without (n = 33) reading disorders were recruited. Participants read the full version of the Russian Sentence Corpus. 144 sentences were randomly divided into 4 parts, two were presented in LexiaD, the other two in Arial.

For each experiment, statistical analysis using mixed effect modeling was conducted. We explored font and group effects on first fixation duration (FFD), gaze duration (GZD), and total viewing time (TVT) while statistically controlling for word length and word frequency.

In the first experiment, both groups when reading in LexiaD had an advantage in FFD[1] (281 ms vs. 294 ms, t = 4.24, p < .01) and TVT (620 ms vs. 679 ms, t = 2.63, p = .01), but GZD (480 ms vs. 454 ms, t = -2.18, p = .03) was shorter in PT Serif font. In the second experiment, LexiaD font was

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[1]   For high-frequency words

less successful than Arial in both groups in GZD and TVT, the difference between fonts in FFD was not significant (FFD: 271 ms vs. 267 ms, t = 1,19, p = .23; GZD: 282 ms vs. 268 ms, t = 2,45, p = .01; TVT: 397 ms vs.379 ms, t = 3,80, p < .001).

The LexiaD font reveals contradictory results. In the primary school group, in some aspects, LexiaD proved to be faster to read and could be recommended to use by children who have a visual deficiency (see the result for FFD) or struggle with text comprehension resulting in re-reading (see the result for TVT). As for adolescents, Arial outperformed LexiaD in all aspects. In the course of further research, it is planned to find out whether the success of Arial in this group is due to its prevalence and familiarity, or whether this font is indeed more efficient.

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Processing of words and pseudowords in the thalamus and the subthalamic nucleus

Although language function is classically considered to be supported by cortical regions, recent theoretical accounts and empirical evidence increasingly implicate subcortical nuclei, such as the thalamus and the nuclei of the basal ganglia, in various aspects of language processing (Kotz, Schwartze, 2010; Tourville, Guenther, 2011; Eisinger et al., 2018). A recent study (Tiedt et al., 2017) compared event-related potentials recorded from the subthalamic nucleus (STN) and the thalamus as participants performed a lexical decision task. A phasic negative activity peaking 300 – 400 ms after prime word onset was found in the STN and a slow positive potential shift during target presentation was found in the thalamus, suggesting a differential role of these structures in lexical processing.

In order to examine the relative contributions of the thalamus and the STN in language further, we recorded local field potentials (LFPs) from patients with essential tremor (n = 11) and Parkinson's disease (n = 13) while they read out monosyllabic words and pseudowords (n = 240) during implantation of subcortical electrodes in the thalamus and the STN, respectively, for treatment of disease symptoms. LFP data were transformed into time-frequency representations on which subsequent analyses were performed.

The identified LFP activity differed markedly in the two structures. Thalamic data revealed a bilateral decrease in power for pseudowords relative to words in the beta frequency range (12 – 30 Hz) starting from stimulus presentation and a left-lateralized increase for pseudowords in the high gamma (70 – 150 Hz) power during spoken response. In the STN, an overall increase in high gamma activity was observed in the pseudoword compared to word trials, but it appeared with a temporal jitter across almost the entire trial epoch from stimulus presentation to spoken response offset.

The observed spectro-temporal differences between the thalamus and the STN during lexical processing provide additional evidence in favor of 1) subcortical involvement in language processing, and 2) distinct functions of the two structures in lexical processing, supporting the hypotheses of thalamic "selective engagement" (e.g., the realization of the behavioral focus) and subthalamic "procedural monitoring" (e.g., inhibition of competition from real words, suppression of habitual responses, switching from automatic to more controlled processing in pseudoword trials).

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Individual differences in prior knowledge application during word learning: A mechanistic Bayesian model

When hearing a novel word, people may infer information about its meaning based on contextual clues or linguistic constraints in-the-moment (theories of hypothesis elimination). Alternatively, word

meanings could be extracted and associatively learned from statistical regularities gathered across experiences (theories of cross-situational learning). Bayesian frameworks of word learning incorporate aspects of both theories: learners use prior knowledge to constrain potential word meanings and use word occurrences, context, and statistical structure to update prior knowledge. We wanted to examine how repeated experience and prior knowledge interact to support word learning by adapting a Bayesian model (Tenenbaum, Griffiths, & Kemp, 2006) to an inferential word learning task.

In our study, adults inferred novel animals' names across multiple trials using varied contextual information (e.g. 'Cotingas nest in forest canopies', 'Cotingas eat seeds') to select the referent picture amongst other known and unknown animals. Contextual information was quantified in a preliminary norming study for each trial, providing an estimate of how likely the novel word (e.g. 'Cotinga') refers to the target picture. Participants returned the next day to be tested on their cued memory of words and contextual information. We created a mechanistic Bayesian Observer model using (i) contextual information of trials (proxy for likelihood), and (ii) participants' selection accuracy in the task (point estimate of the posterior distribution) to (iii) infer their prior distribution, a proxy for the participants' belief before exposure to contextual information. Prior distributions were inferred at six time points, and we defined the shape of each distribution by its mean and standard deviation. To look at learning across the task, each participant's selection accuracy and prior distribution was defined as a linear trajectory with a unique intercept (starting point), slope (change) and error (change). In separate models, these terms were compared at predicting next-day name recognition.

Comparing intercepts, the mean of the prior distribution was predictive of name recognition performance (b = 6.03, p = .021) but selection accuracy was not (β = 11.74, p = .190). Those who efficiently applied their prior knowledge at the start, recognized more animals; these are not necessarily just the same people who did well at the start. Comparing error, the mean of the prior distribution was predictive for name recognition (β = -77.47, p < .001) but selection accuracy was not (β = -81.47, p = .742), suggesting that successful learners incrementally updated how precise their prior distribution was across the task.

A cluster analysis found four learning strategies in the task that varied reliance on prior knowledge and accumulating statistical regularities. The most successful word learners both effectively utilizing and updating their priors (i.e. Bayesian learners). Our results suggest that there are individual differences in word learning strategies and how prior knowledge is applied when encountering novel word-object associations, which determines memory formation.

SLIDE SESSION 3

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Can we identify a word by its upper half? ERP correlates of letter degradation during word recognition

Skilled readers are able to rapidly match a word's visual features with the appropriate lexical representations in long-term memory. Although models of visual word recognition assume that both upper and lower halves of a word are equally important, prior research has obtained a clear advantage of the upper half (Perea, 2012). This pattern suggests that: either the perceptual information in the word's upper part is informative enough to retrieve lexical information; or that the cognitive system rapidly compensates perceptual degradation to select a lexical match (i.e, top-down lexical feedback).

To disentangle these two explanations, a lexical-decision ERP experiment was conducted with intact vs. degraded stimuli (the upper part of the words/non-words). The words and non-words were composed of unambiguous letters in their upper portion (e.g., "i" or "j" were not included). Word-frequency (high- vs. low-frequency words) was also manipulated.

The behavioral data showed that low-frequency words elicited longer response times than high-frequency words (694 vs. 661ms; $p < .001$) and that degraded words elicited longer response times than intact words (696 vs. 658ms; $p < .001$). The interaction between the two factors was not significant ($F < 1$). The ERPs showed that, for words, degraded stimuli elicited larger amplitudes compared to the intact stimuli at a perceptual component (N/P170: -1.7 vs. -.47; $p < .001$) and at categorical levels of processing (P300: 3.2 vs. 1.7; $p < .001$). This pattern was observed across non-words too (N/P170: -1.3 vs. -.27; $p < .001$, P300: 3.0 vs. 1.2; $p < .001$). Notably, the latency of the word-frequency effect was shorter for degraded words (350–400ms: degraded: $p < .05$; intact: $F < 1$) than for the intact words (400–500ms: degraded: $p < .01$; intact: $p < .05$).

Results revealed early ERP differences for degraded compared to intact stimuli. The degraded stimuli may demand more attentional cognitive resources, as shown by an increase of early ERP amplitudes in the degraded condition. Second, there was earlier top-down lexical feedback for the degraded vs. the intact condition (word-frequency effects occurred earlier for the degraded than for the intact stimuli). These results are consistent with a process of normalization during amodal completion that is sensitive to higher-level (lexical) feedback.

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Differential effects of tDCS of Wernicke's area and its right hemisphere homologue on contextual acquisition of novel words

Despite many decades of research into language mechanisms, its neurocognitive foundations remain unclear. Among some of the most poorly understood issues are the neurophysiological mechanisms

underpinning acquisition of abstract and concrete words. One way to address this is to apply neuromodulation methods to investigate causal relationships between stimulated brain areas and their linguistic functions.

The present study was aimed at investigating the influence of anodal and cathodal tDCS of Wernicke's area on novel words acquisition. Twenty novel word forms and novel meanings (abstract/concrete) were created. Participants (native Russian speakers) learnt novel words from contextual sentences. The sample included 5 groups (24 people in each) who received 15-min 1.5 mA anodal, cathodal or sham tDCS of Wernicke's area or anodal/ cathodal tDCS of its right-hemispheric homologue (RHH) before learning. Learning outcomes were assessed using free recall, recognition, lexical decision (LD), free-form definition (FFD) and multiple-choice semantic judgment (MSJ) tasks, which were implemented immediately after learning and on the next day. Mann-Whitney tests with FDR corrections were used for statistical analyses.

Between-group comparisons revealed a positive effect of cathodal tDCS (vs. sham) of Wernicke's area on Day 2 ($p = .078$) and of anodal tDCS of RHH (vs. cathodal tDCS of RHH) on Day 1 for abstract words ($p < .036$) in FFD task. Comparisons between hemispheres showed that cathodal tDCS of Wernicke's area was more effective than cathodal tDCS of RHH for abstract words on Day 2 in the MSJ task ($p = .031$).

Within-group analysis revealed a decrease of performance on Day 2: for all novel words in all groups ($p < .028$) in FFD, except abstract ones in cathodal Wernicke group; for concrete words in anodal Wernicke group in MSJ ($p = .004$) and in anodal RHH group in recognition task ($p = .032$).

Stimulation polarities and loci differentially affected word acquisition on lexical and semantic levels, which was particularly expressed for abstract words. We found a facilitation of acquisition after cathodal tDCS of Wernicke's area. The opposite effect appeared for the same polarity applied over its right hemispheric homologue. This can be explained by different involvement of two hemispheres in semantic representations, as well as by indirect influence of tDCS of contralateral cortical areas through cross-callosal connections.

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Eye movements during reading in Russian-speaking children with dyslexia

Dyslexia is a developmental reading disability that impedes reading fluency and text comprehension (Benfatto et al., 2016) and is believed to stem from phonological deficit, visual attention span deficit or a combination of both (Zoubrinetsky et al., 2014). This study aimed to investigate the influence of phonological skills and word properties on eye movements during reading in Russian children with phonological dyslexia compared to the control group of typically developing children.

Primary school students with diagnosed phonological dyslexia (N = 29, mean age = 9.5) and typically developing controls (N = 47, mean age = 8.5) participated in our study. We ensured that all controls read normally according to the Standardized Assessment of Reading Skills in Russian (Kornev, 1997). Phonological processing skills were assessed using the Russian Test of Phonological Processing (RuToPP; Dorofeeva et al., 2019). In the eye-tracking experiment, all children silently read 30 sentences comprising the child version of the Russian Sentence Corpus (Laurinavichyute et al., 2019) while their eye movements were recorded.

Overall children with dyslexia read slower than controls, and were more likely to skip a word (p = .003). Older children read faster, however, this effect was less prominent in children with dyslexia (p = .02). Children with dyslexia spent more time on longer words compared to controls (p = .01). We also found that greater amplitude of the incoming saccade correlated with shorter reading time, which was amplified for children with dyslexia (p < .001). Difficulties with the most complex phonological task in RuToPP correlated with longer fixations, which was more prominent in children with dyslexia (p = .05).

Difficulty with the complex phonological task and the effect of the amplitude of the incoming saccade in children with dyslexia could indicate that impaired phonological processing as well as problems with targeting the optimal landing position in a word prevented them from reading

effectively. We also found that only the effect of word length was strongly distinguished between children with dyslexia and controls, whereas the effect of the other word properties needs to be investigated further.

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Phonological and orthographic processing affect reading fluency in Russian children

Reading, as a complex cognitive skill, implies processing of visual and linguistic information. At early stages of learning to read children rely more on the phonological information, whereas more advanced readers tend to rely more on the orthographic information (Grainger et al., 2012; Ziegler et al., 2014). The aim of the present study is to investigate how phonological and orthographic processing skills as well as age influence reading fluency in Russian-speaking children.

81 Russian monolingual children at the age of 7–12 years (grades 1–5) performed three behavioral tests. First, reading fluency (i.e. the number of words read in one minute) was assessed by the Standardized Assessment of Reading Skills (Kornev, 1997). Second, the level of phonological processing was evaluated by the Changing Sound in a pseudoword test (Dorofeeva et al., 2019), in which the participants were asked to replace a specific phoneme in an auditorily presented pseudoword with another given phoneme. Third, orthographic processing was assessed by the Rapid Automatized Naming of Digits task (RAN; Denckla, Rudel, 1974), in which we recorded the amount of time spent on naming 50 digits.

Linear regression analysis of the data was performed in R (version 4.0.2). We discovered a significant correlation between reading fluency and

all the three predictors: higher phonological awareness speeded up reading (t = 4.399, p < .001), faster performance in RAN speeded up reading over and above phonological processing (t = -3.282, p = .0016), older children read faster than younger ones (t = 4.425, p < .001).

We found that both phonological and orthographic processing skills had an important impact on reading fluency in Cyrillic script for young readers. Crucially, we showed that all the three predictors, i.e. phonological skills, orthographic processing skills, and age separately influenced reading fluency. Therefore, we can conclude that reading development in Russian-speaking children is based on the development of both phonological and orthographic processing.

SLIDE SESSION 4

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Different types of regressions as a text processing skills indicator: Eye-tracking study of reading in 9–11 years old dyslexics

A large number of dyslexia studies are devoted to the decoding difficulties. Nevertheless, the dyslexic children skills of checking the correctness of conclusions and coherence of the text remain poorly understood. Eye tracking of different regressive saccades while reading is an effective method for testing these reading skills. The aim of our study was to analyze oculomotor indices of different regressive saccades for dyslexic children and their healthy peers while reading.

The study involved 26 dyslexics and 44 typically developing children from 9 to 11 years old. Eye movements have been recorded by SMI RED500 eye tracker when children were reading two scientific texts. Regressions were divided into micro-regressions (of 2–3 symbols amplitude), short regressive saccades (of 3–6 symbols amplitude), medium-length regressions (of 6–16 symbols amplitude) and large-length regressions (with amplitude exceeding 16 symbols). Mean count and frequency of occurrence for

different regressions were analyzed. The results were statistically evaluated and tested for differences using the Mann-Whitney test.

Statistical analysis revealed significant between-group differences related to the number of all types of regressive saccades. Dyslexics produce more micro-regressions (p < .001), short regressive saccades (p < .001), medium-length regressions (p < .001) and large-length regressions (p < .001). After that, the frequency of occurrence of all types of regressive saccades was analyzed. It was found that dyslexic children are more likely to produce micro-regressions (p < .05) and short regressive saccades (p < .01), while less likely to produce medium-length (p < .01) and long-length (p < .05) regressive saccades in comparison to typically developing children.

Dyslexic children are more likely to produce micro-regressions and short regressive saccades occurring due to decoding errors. Moreover, our results allow us to conclude that dyslexic children have difficulties not only in decoding but also in the skills to check the correctness of conclusions and coherence of the text model. These difficulties are reflected in the low frequency of occurrence of medium- and long-length regressions.

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The impact of capitalization of German nouns on semantic processing

In German orthography, both proper and common nouns are capitalized in their first letter (e.g., *Haus* [house]). But do German readers benefit from early access to grammatical information of capitalized nouns or is it just a historical legacy? Prior experiments with a lexical decision task in German have shown faster responses to capitalized than lowercase nouns (*Haus < haus*) as well as less neural activation in the Visual Word Form Area (Wimmer et al., 2016). Furthermore, the reverse pattern occurred with adjectives/verbs (*blau* [blue] < *Blau*). These findings suggest a facilitative

role of capitalization for German nouns. However, there is an interpretive issue: lexical decision times are heavily dependent on visual familiarity (i.e., the advantage of *Haus* over *haus* could have been due to its higher visual familiarity). To focus on semantic activation while minimizing the role of visual familiarity, we used a semantic categorization task ("Is the word an animal name?"; see Perea et al., 2020).

We compared word identification times to German words that were presented in their standard format (*Hund* [dog]*, Haus, blau*) or not (*hund, haus, Blau* [Experiment 1]; *HUND, HAUS* [Experiment 2]) to German native speakers (N = 42 and N = 46 in Experiments 1 and 2, respectively).

In Experiment 1, Bayesian linear mixed-effects models showed faster responses for animal nouns with initial capitalization (*Hund < hund*, 95% Credible Interval (CrI) [18.6, 29.9]), faster responses for lowercase non-nouns (*blau < Blau*, 95% CrI [25.6, 40.9]), and, surprisingly, faster responses for lowercase non-animal nouns (*haus < Haus*) (95% CrI [10.6, 26.0]). This latter difference may have been an artifact of the task (i.e., *haus* does not follow German orthographic rules and also requires a "no" response). Indeed, in Experiment 2, when using an orthographically legal uppercase format, we found a similar advantage for animal and non-animal nouns with initial capitalization (*Hund < HUND* and *Haus < HAUS*, 95% CrI [3.0, 12.5]).

German readers benefit from the initial capitalization of the nouns. Although models of visual word recognition assume that letter-case information is lost early during word processing (see Vergara-Martínez et al., 2020), we have shown that this information is preserved and used during semantic processing in German.

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The effect of different types of semantic cues on word retrieval success in tip-of-the-tongue states

The Tip-of-the-Tongue (TOT) state is an experience when a person has a strong feeling that they know a word but cannot retrieve it at the

moment. Cues, including semantic ones, can help to resolve TOT states. But it remains unknown which cue types are the most effective. This study is aimed at finding out what type of semantic cues helps to relieve a ToT state more effectively.

We conducted an online experiment in which 19 young participants were asked to name 102 words by their definitions. All words had low frequency in order to elicit more ToT states. If participants could not retrieve the target word, they were asked if they experienced a ToT state and then were shown a cue semantically related to the word: either an association or a cohyponym. According to the theory of partial activation and the results by Meyer and Bock (1992), we hypothesized that cues would help rather than interfere with the retrieval of the target word. According to the blocking theory and the results by Jones and Langford (1987), we hypothesized that association cues would be more effective, because cohyponym cues would compete with the target word for activation, as cohyponyms and the target word are very closely connected in the mental lexicon.

ToT states occurred in 14% of cases. After ToT states, the average percentage of correct responses was 18% after association cues and 17% after cohyponym cues. Without ToT states, the average percentage of correct responses was 1% after association cues and 0% after cohyponym cues. Analysis of variance showed a significant effect of presence of the ToT state (the participants more often named the correct word after a cue if they initially experienced a ToT state, $F(1.18) = 19.8$, $p < .001$). There was no significant effect of the cue type or interaction between the cue type and presence of the ToT state.

The paradigm was able to elicit ToT states, although possibly an insufficient amount for high statistical power. As expected, cues were more effective when a person reported a ToT state than when they did not. The results confirmed the partial activation theory: the cues helped rather than prevented the retrieval of the target word. The blocking theory was not confirmed in our study: the results did not show a significant difference between cohyponyms and associations in resolving ToT states. Our findings preliminarily suggest that any semantically related words can help to retrieve the target word during ToT states.

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Systematicity in language

Systematicity is pervasive in the human brain, at all levels of structure and function. In language there are systematic relations between phonological forms of spoken words and their meanings: words that sound similar tend to have significantly similar meanings.

We extend this research to Korean, using the Mantel Test to assess isomorphism between word-level phonological space and semantic space, for a representative sample of the lexicon (Monaghan, Shillcock, Christiansen, & Kirby, 2014). We measure phonological distance in feature edits, and semantic distance by cosine distance between context vectors from a large text corpus. We measure the correlation between all corresponding pairwise distances in the two spaces; a correlation indicates systematicity.

We also use this methodology to quantify systematicity between individual letters and their canonical pronunciations, using Hausdorff Distance (Huttenlocher, Klanderman, & Rucklidge, 1993) for visual differences and feature-edits for phonological distances.

We replicate the finding of word-level systematicity between phonological form and meaning in Korean.

We further divide our sample of the lexicon in terms of word frequency, syntax, syllabic constituents (onset, vowel, coda, rhyme), etymology (pure and Sino-Korean), vowel type, homonyms, loan words and onomatopoeia. However we partition the sample, significant systematicity emerges in each subset.

We find significant systematicity between the visual form of individual Korean letters and their canonical pronunciation. Letters that look similar tend to be pronounced similarly. This result extends to other alphabets.

Systematicity is potentially adaptive in learning a first language, in adult language processing, in learning to read, and in skilled reading. Such systematicity may be a language universal.

We propose here that such systematicity, although real, is a necessary result of language use. It is strongest in more frequently occurring words. Frequently spoken words converge phonologically, due to Zipf's Principle

of Least Effort: they are shorter and contain simpler vowels. Frequent words also converge in their context vectors; by occurring frequently they have more opportunity to acquire different contexts – in the limit, their context vectors approach the average one for the text corpus.

Frequently written letters and frequently spoken canonical pronunciations likewise follow the same Principle of Least Effort, leading to systematicity.

FLASH TALKS SESSION 1

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Maturational changes of ERP N400 and P600 components elicited by repeated written words in children, adolescents, and adults

It is often stated that, for adults, repeated words in the old/new written word paradigm elicit a larger amplitude of P600 and smaller N400 components than new words do. The question whether N400 and P600 underlie different cognitive processes is still under debate. The developmental trajectory of N400/P600 components during the recognition could help to solve the problem. This work is aimed at comparing ERP components during word repetition effect in children, adolescents, and adults.

We examined adults of 19–26 years old (N = 22), children of 9–10 (N = 25) and adolescents of 12–14 years old (N = 17). During the first step, a pair of nouns was presented to the subject, during the second step — the single word was presented, which could be a new one or a repeated

word from the first pair. In total, there were 100 stimuli of each type in the categorical decision paradigm. EEG was recorded from 19 sites, located according to the 10/20 system with a sampling rate of 500 Hz. The ERP was assessed for 1-sec intervals separately for new and repeated words in each of the age groups. We compared the amplitude and latency of the peaks in the ranges of 350–550 and 550–900ms using the Wilcoxon T-test.

The effect of age was found for the amplitude but not for the latencies of P600 and N400, both in case of the new and repeated words in averaged P3, Pz, P4 (P600) and F3, Fz, F4, C3, Cz, C4 (N400) sites. The N400 between-stimuli differences were discovered only in adults: the latency of the N400 peak was significantly lower for a new word than for a repetitive one (Z = -2.64, corrected p = .048). Differences in the amplitude of the P600s elicited by new and repeated words manifested in adolescents (Z = -2.91, corrected p = 0.024) and adults (Z = -2.84, corrected p = .030). In both groups, the amplitude was higher in repeated word trials.

Comparison of old and new visual information involves several stages, which are formed at particular ages and reflected in different ERP components. Differences appear between the repeated and new words in the P600 component, and at 12–14 years old the pattern of differences is similar to adults. At the same time, N400 differences are not detected in childhood and adolescence and are present only in adults. Based on different developmental trajectories of N400 and P600 we can assume the different nature of cognitive processes underlying the two ERP components.

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Visual perception of iconic words depending on their deiconization stage

Iconicity is a systematic association between the sound and the meaning of a word. Our previous research has shown that iconic (imitative) words

are characterized by slower visual identification and higher error rates compared to arbitrary ones (Tkacheva et al., 2019). In order to understand possible cognitive mechanisms underlying this process we studied the interrelation between the words' stages of de-iconization (loss of imitative quality) and the speed of their recognition.

Pre-selected Russian and English iconic words were divided into 4 groups according to their de-iconization stage (Flaksman, 2017), so that the words in the first group (SD-1) had an evident form-meaning correlation, while the words in the fourth group (SD-4) had lost sound-meaning association due to historical phonological and semantic changes. All the stimuli were counterbalanced according to their frequency of occurrence. The Lexical Decision task was used to examine the visual perception of iconic words by Russian-speaking subjects (N = 106).

The time of stimuli recognition significantly depends on the stimulus type. The effect is large: partial Eta Square = .286, explaining 28.6% of the reaction time variance for Russian words (F (4; 101) = 10.121; p < .0001) and partial Eta Square = .385, explaining 38.5% of the reaction time variance for English words (F (1; 103) = 39.382; p < .0001). Russian SD-1 words were identified the slowest, while SD-3 words were recognized the fastest, even in comparison with arbitrary words. English words from groups SD-1, SD-2, SD-3 were identified more slowly than both SD-4 words and arbitrary words. Also, SD-1 words were recognized with more errors than other imitative and arbitrary words, regardless of the language. The difference in response accuracy between iconic and non-iconic words is statistically significant (Chi-Square = 26.001; df = 2; p < .001 for Russian words and Chi-Square = 91.274; df = 2; p < .0001 for English words): the response accuracy for iconic words is lower than that for non-iconic words.

We assume that the delay and a low accuracy in the recognition of SD-1 words for both languages are accounted for by their diffuse semantics and weak syntactic ties. In fact, the time of their recognition is close to that of non-words. We presume that the lack of syntactic integration combined with high degree of iconicity reduces the speed of recognition. However, Russian SD-3 words being fully integrated syntactically and still clearly perceived as iconic are recognized the fastest. The present study will be replicated with English native speakers for validation.

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A normative study of Russian-language general knowledge questions

In the absence of normative data, the first stage of any experiment is to perform a normative study to guarantee adequate experimental control. In the case of studies on general knowledge a large sample of participants and questions is needed in order to obtain a comprehensive set of general knowledge questions of different levels of difficulty. There are several banks of normative general knowledge questions for some languages and cultures (e.g. Tauber et al., 2013 for US English; Duñabeitia et al., 2016 for Spanish-Spain), but, because of differences in cultural backgrounds and in national educational programs, general knowledge is country- and language-specific, making the mere translation inadequate.

In this study we aimed to norm 500 general-knowledge multiple-choice questions for Russian language. The questions covered different topics — General, History, Science, Culture, and Geography. 103 native Russian speakers answered the questions by selecting one out of four alternatives. After that, participants indicated their confidence in their selection; confidence ratings provide further valuable information about the subjective experience associated with the objective measure of accuracy. We conducted statistical analysis of accuracy and confidence data, considering the entire sample and also splitting it by participant gender. We also assessed the information about the selection for the lures (wrong answers).

The results (Martín-Luengo et al., 2020) show that the sample of questions used in the study covered all the difficulty levels. The results on confidence indicate that none of the questions were misleading (e.g., questions for which participants usually provide wrong answers with high confidence). Our analysis also shows the lack of differences in accuracy between females and males ($p > .05$), but overconfidence in the male sample for answers within the topics of History and Geography ($p = .0008$).

Discussion. This is the first attempt to create a comprehensive database of general-knowledge questions in Russian language. This database can be used to better control conditions in surveys, psychological, educational and neuroscientific studies.

Recently accepted manuscript reporting this research can be accessed here: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.545304/full

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Pitch and size in cognitive processing of verbal and non-verbal stimuli

This paper presents the study of cross-modal correspondences between audial and visual features. Cross-modal correspondences and interactions play an important role in embodied cognition. Previous studies indicate that there is a correspondence between pitch and size (Marks, Hammeal, & Bornstein, 1987; Mondloch et al., 2006). We explored how deep such cross-modal correspondences can be and whether they remain present for verbal stimuli. We used two pure tones (high 1500 Hz or low 1000 Hz). We studied visual feature (size) on different levels, beginning with real objects (circles) and going further to the words with 'size' component in semantics. The purpose was to widen the knowledge about the correspondences of auditory and visual modalities and to increase the efficiency of processing signals from the outside world coming from different channels of perception.

In order to verify the validity of the cross-modal correspondences we carried out 3 experiments. The 1st experiment partially replicated the (Evans, Treisman, 2010) paper. The sample comprised 40 participants (18 to 23 y.o.) in the 1st experiment; 40 (18 to 22 y.o.) in the 2nd; and 31 (20 to 25 y.o.) in the 3rd experiment. They performed the speeded classification task evaluating audial stimuli. The procedures of the 3 experiments were similar. Each experiment consisted of 2 conditions (congruent, incongruent). Respondents heard a pure tone (high or low) played for 120

ms through the speakers and discriminated it by pressing the necessary key on the keyboard. In the 1st experiment, participants saw a circle (big or small), when they heard a pure tone (high or low). In the 2nd and 3rd experiments, respondents saw a word with semantic component of 'size', which differed for each of the experiments. The words "большой" and "маленький" (adjectives) in which 'size' is the main semantic component were used in the 2nd experiment. In the 3rd we used words (nouns) in which component 'size' was peripheral ("муха", "башня"). The stimuli in the 1st and 2nd experiment were presented using program E-Prime 2.0. The 3rd experiment was held online. The dependent variable in these studies was reaction time (RT) measured for correct trials only.

The 1st and the 2nd experiments revealed cross-modal correspondence. Participants' responses were faster when they saw a small circle and heard a tone with a high pitch (congruent case) than in the incongruent case ($p = .027$). When respondents saw a word with semantic component 'small' and a congruent sound, their RT was less than that in case a word was accompanied by an incongruent sound ($p = .013$). In the 3rd experiment, we did not get statistically significant results. The reason for this might be the online approach or the fact that the 'size' component in semantics was not clear enough.

Thus, cross-modal correspondence can be observed in verbal stimuli, but it depends on the intensity of the semantic component of 'size'.

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Emotion manifestation in speech and facial expression in children with autism spectrum disorders and Down syndrome

The presented study is part of the research of speech and voice features in children with atypical development (Lyakso et al., 2016–2020). The aim of the study was to reveal the abilities of children with autism spectrum disorders (ASD) and Down syndrome (DS): 1. to recognize the emotional

state of children by their facial expression; 2. to manifest the emotions in speech and facial expression.

The participants of the study were 20 children of preschool and primary school age with ASD and DS. The study included two model situations: 1. dialogue with an adult — the experimenter used a standard set of questions about favorite games/lessons, friends, and parents and the child answered; 2. after the dialogue the special task was offered — the child looked at images (pictures) of children's faces demonstrating the emotional states: neutral, sadness, joy, anger, fear. The child had to identify the emotional state and describe the picture. The pictures were selected on the base of the prior perceptual experiment — 100 adults recognized the emotional state of the child shown in the image with accuracy more than .75. The audio and video recording of children's speech and facial expression was made.

It was revealed that the children recognized the state of sadness and had issues with identifying fear and neutral emotional states. Children with DS recognized emotional states and manifested in their voice and facial expression the emotional state corresponding to the pictures more often than children with ASD did. Children with DS were more successful in demonstrating a neutral state (42% of the time) and joy (21%), less successful in demonstrating fear, anger and sadness. Children with ASD expressed a wide range of emotional states that were not corresponding to the interaction situation and the task. They showed neutral state 57% of time, anger — 17%, joy and sadness — 12% of time. Acoustic features of speech and vocalizations of children when describing emotional states were revealed. The emotional speech of children with ASD and DS was obtained and its features were compared with acoustic features of spontaneous speech of children in dialogues with adults. High values of pitch and pitch range in ASD children's speech ($p < .01$ — for pitch values of vowels; $p < .001$ — for pitch range values; Mann-Whitney test) and low values of vowel articulation index in DS children's speech were revealed ($p < .05$).

The results of the study can be used for developing communication skills in children with disabilities. The study could be continued by exploring the features of speech and facial expression of children when recognizing emotions from video fragments of facial expression.

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Gestural coding of animated referents

Our study shows the interconnections between head movements, hand gestures and verbal referents in narration.

Our research based on the RUPEX multimodal corpus studied hands and head movements ovelapping with referential expressions (subcorpus with 974 hands gestures and 1053 head gestures was chosen).

For gestures accompanying animated referents, we analyzed functional types of head and hands movements of the speaker and head gestures of the listener, since it is not common for the latter to gesture with her hands while listening, albeit head nods and tilts are highly expected as indicators of attention and feedback.

Head and hands gestures were analyzed using comparable principles while taking into account the differences between the channels. Unlike many studies, we annotated all head movements, and the annotation scheme for hand and head gestures was unified using similar classification of functional types: we distinguished depictive, pointing, pragmatic and beat gestures in head and hands, and regulators for head gestures.

Depictive hand gestures more often (13%) appear when a speaker mentions animate characters. In earlier studies, prominence in discourse was considered as an important feature determining choice of more elaborated depictive hand gestures rather than metaphoric, pointings or beats, while animatedness is still understudied. In contrast, gestures marked as metadiscoursive in our study (comparable to McNeill's metaphoric) are 16% less probable with animate characters. Head gestures emphasize reference to people too, listener's gestures function similar to the speaker's ones. In addition, both interlocutors use head pointing gestures and regulators for creating and maintaining common ground and shared attention.

Gestures are known to reveal discourse structure, e.g. highlighting the main line or adding stance or evidentiality markers. Our research shows that animatedness is an important feature influencing the use of both hands and head gestures, thus we point at pragmatic as well as semantic meaning in all groups of gestures. It can be explained by alignement features:

while hand gestures which are usually longer transfer information related to clauses, shorter head gestures can be used to mark single words. The listener's nonverbal behavior also plays a crucial role for understanding commonly built discourse structure.

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Diagnostics of speech as a predictor of schizophrenia development in clinical psychology

The search for prognostic criteria for the risk of schizophrenia development is becoming increasingly important in clinical practice. Even though speech processes have not been an independent subject to pathopsychological diagnostics, their functioning characterizes pathological changes in cognitive sphere and personality and could be regarded as a diagnostic parameter at the initial stages of schizophrenia development. Based on this, it is necessary to expand the methodological potential of pathopsychological diagnostics for more thorough assessment of personality characteristics and the course of mental processes through examination of speech and speech-thinking processes.

Participants with schizophrenia spectrum disorders: patients with the first psychotic episode (N = 12; M = 19; SD = 2,37) and patients at high mental risk state (N = 19; M = 22; SD = 3,06); controls (N = 25; M = 22; SD = 3,57). The groups included only males.

The tested speech parameters were: the associative process assessed with the method of free associations (Zeigarnik, 1986); reconstructing of figurative meaning assessed with the "Fables comprehension and scoring" (Shcherbakova, Nikiforova, 2016); speech perception based on the certain linguistic aspects assessed with the text "A case with Oliver" (Chernov, 2017).

Statistical comparison of the groups was performed by the Kruskal-Wallis H-test.

The two clinical groups differed in all of the speech parameters: patients at high mental risk, compared to the group with the first episode, were characterized by more successful understanding of figurative meaning (p = .018), their associative processes were less abstract (p = .067) and less characterized by personal significance (p = .014), their speech perception relied more on semantic (p = .023) and grammatical (p = .016) characteristics of verbal information. But, in contrast to controls, they were less likely to use specific associations (p = .003). The decrease in ability to extrapolate one common figurative meaning to various situations in the risk group was closer to that in the schizophrenia group.

Although there are obvious differences between the two clinical groups in the severity of speech disorders which appeared after the disorder manifestation, some features, such as the decrease in the specificity of associations and the decrease in the ability of understanding the same figurative meaning of formally different situations, could be potential markers of future schizophrenia development.

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Expression of causality in the utterances of the early aged Russian-speaking children about objects and physical phenomena

The study examines the linguistic expression of causal relations in the utterances of children speaking about physical objects and natural phenomena. The study is based on the ideas of Sergienko (2009) that there are two different ways of understanding causality: (1) understanding of physical causality that helps to explain the "behaviour" of inanimate things and (2) understanding of mental causality that helps to explain the behaviour of living creatures. The goal of the study is to trace the acquisitional patterns of verbalization of certain types of causality at the earliest stages of language development.

The data consists of 400 utterances with causal semantics extracted from the spontaneous speech of 25 typically developing Russian-speaking children aged 12–42 months. The utterances have been analysed using the functional semantical method and divided into groups according to their meaning and children's age.

The first causal utterances appear at the stage of one-word phrases (14–15 months) and describe (a) changes in a physical object caused by an external force and (b) a physical object as a modifying factor, reflecting children's interactions with objects in the nearest environment. From 23–25 months, children are able to distinguish animate and inanimate objects and 2–4 months later start speaking about object's internal mental states as causes of events. Up to the age of 30–32 months, the main means of expressing of causal relations are causative verbs, complex non-union sentences, as well as nominal syntaxes with causal meanings. Complicated and complex sentences with subordinate reasons are also sometimes used by children, but are not yet among the main means. Children demonstrate individual differences in the sequence of assimilation and the repertoire of the means used.

Children of early age may declare both external and internal motives (which are usually characteristics of living beings) to be causes of physical events. The results agree with the ideas of Sergienko (2006, 2008) and Gelman and Wellman (1991) according to which various levels of organization of mental models form the base for the interpretations of physical and mental events and become more complicated with the development of understanding of physical objects.

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High and low pitch within the pre-nucleus: A perception experiment

In the traditional British descriptions, the intonational meaning of a phrase is conveyed by the melody within the nucleus (the main word), which is usually in the final position (e.g., O'Connor, Arnold, 1978). The pre-

nuclear part of the phrase, the head, may be pronounced in different ways, but, in general, heads themselves do not convey any specific meanings. In Russian, there seem to be at least two types of heads: high and low, of which the high head is much more frequent. This study aims to find out whether naïve listeners are able to perceive differences between the high head and the low head based on prosody only. Our experiment relies on the assumption that parentheticals can be taken as a reference point, since they seem to be pronounced in a low pitch cross-linguistically (e.g., Bodenbender, 1999).

From the corpus of Russian read speech CORPRES (Skrelin et al., 2010) we selected utterances of three types: A) containing a parenthetical (an author's remark) with low head, B) containing no parentheticals and a high head; C) containing a phrase with low head but no parentheticals. There were 4 examples in each group. Each example consisted of three or four tone units, and the phrase with low head, if present, was in the middle. All the recordings were made by the same speaker (a female). Then the 12 recordings were de-lexicalized by reducing the bitrate to 6 bits per sample; the melodic curve remained intact and could be heard clearly after the modification. The resulting stimuli were presented to 25 native Russian speakers in random order. The task was to mark those utterances where author's remarks (such as "he said", "Elena asked again", "replied Dmitrii in a quiet voice") could be present. The listeners were aware that the recordings had been modified.

The number of listeners that assumed the presence of author's remarks in the stimuli was 55% for group A, 25% for group B, and 52% for group C; repeated measures ANOVA showed high significance for the factor of group ($p < .001$); post-hoc paired t-tests showed no difference between groups A and C ($p = .7$) and highly significant differences in pairs A-B and B-C ($p < .001$).

Our results show that listeners can distinguish between the high head and the low head and, therefore, may be able to use them in speech production intentionally. Thus, e.g., professional speakers may use the following technique: in long utterances, where most tone units are pronounced with high heads, they occasionally use low heads to make speech less monotonous.

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Early stages of the acquisition of verbal grammar by Russian-speaking 1-to-3-year-old children (based on the CHILDES corpus)

The purpose of the present study is to investigate the timeline of the acquisition of verbal grammatical categories in young children during their first three years of life. For that we analysed two corpora of longitudinal speech recordings: a corpus of a boy Y whose speech was recorded from 1 year 5 months till 3 years and a corpus of a girl T whose speech was recorded from 10 months till 3 years. We also analysed the parents' speech in both corpora and compared the usage of different grammatical categories in parents' and children's speech.

Child-parent everyday interactions were video-recorded and transcribed according to the guideline of the CHILDES database (Snow, 1977). The overall size of the Y corpus is 57184 tokens and the size of the T corpus is 37252 tokens. All the data were morphologically annotated using Pymystem3. Morphological homonymy was disambiguated by an annotator (only for Y corpus). We analysed the usage of verbal aspect, tense, person, and number. We also looked at the usage of infinitives and imperative forms, because previous studies showed that the number of these forms decreased with age and they were substituted by personal verb forms (Gvozdev, 2008).

First, we found that, overall, both children produced more imperfect than perfect verbs, which was in line with previous findings for Russian (Gagarina, 2008). Second, we showed that past tense was more frequent at the early stage of language development, but starting from the age of 2 children used present tense more often than past tense. Interestingly, future tense was the least frequent in our data during all periods of language development. This finding is in line with previous studies (Gagarina, 2008) and could indicate that future tense is acquired later. Third, we found that 2nd person verb forms were acquired last, which is in line with previous findings. However, 1st person was produced earlier and more often that 3rd person which contradicted previous observations (Gagarina, 2008). Fourth, our results showed that verb forms in singular are acquired earlier than in plural. Finally, in line with

our expectations, the number of imperatives in children's speech gradually decreased. However, the number of infinitives increased. Surprisingly, we found that statistical properties of verbal grammatical categories in parents' speech did not change as children grew older.

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When seeing is not believing: The role of illustrations in judging the reliability of information

According to the theories, successful understanding of multimedia texts is determined by cognitive processing of both verbal components and pictures (Mayer, 2014). However, the specific role pictures play in this processing is still unclear. Particularly, pictures of different degrees of accuracy are often used for representing the core idea of a text in a schematic way (Spiegelhalter, Pearson, & Short, 2011), and readers need to assess by themselves how accurately each illustration represents the respective idea. In one of the previous studies it was shown that the degree of accuracy of verbal information (represented by words like "presumably" or "surely") has more significant impact on cognitive processing of a text than particular type of visualization (schematic or realistic pictures; Glaser, Schwan, 2019). But the question whether judging the reliability of information differs for texts with pictures and without them remains open. Thus, the aim of this study was to investigate the role pictures play in mechanisms of judging the reliability of information.

We tested the following hypothesis: judgements of reliability of information vary between texts with pictures and those without them. Procedure: 20 slides with false facts were presented to 200 naïve participants (aged 15 — 56, M = 29; 88.5% female). A half of these slides presented the information in a purely verbal form, while another half included a picture illustrating a verbally described fact. The experimental task was to judge whether a fact was true or false and self-assess the confidence of each single judgement. The data was analyzed with comparative methods.

The results showed that participants more often judged false the facts that were presented along with pictures in comparison to those presented

in purely verbal form (χ^2 = 12.38, p < .01). The respondents reported higher confidence for judgements about the accuracy of information in case the verbal descriptions of facts were accompanied with pictures (t = 2.26, p = .02). However, this pattern was only expressed for those responses that judged information false (t = 1.93, p = .05), but not for those that judged that as true (t = 0.29, p = .77).

Presumably, our results can be interpreted as an evidence of destructive effect of pictures incorporated into verbal texts on the buildup of respondent's own mental representations of the information provided. When perceiving illustrative components of pictures, respondents could take them as 'prêt-à -porter' mental imagery substituting the proper cognitive processing of a text and developing its adequate and detailed mental model. Stimulus pictures could block this process because the texts' implausibilities were duplicated (presented both verbally and visually) and could not be corrected during natural conversion of information from verbal form into its mental model. Contrary to this, in case of working with verbal information only, participants developed its mental representations that were coherent with their basic knowledge. To conclude, judgements of reliability of information are higher for texts presented without pictures. This can be explained by reader's more critical attitude to information caused by double processing of verbal and visual representations of a fact that does not correspond to the readers' knowledge.

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Embodied lexical access to emotional words in bilinguals

Grounded cognition view predicts correspondences between word semantics and sensorimotor behaviour (Barsalou, 2010, 2016). For

instance, access to words with typical spatial connotations (e.g., foot, sun) results in automatic attentional shift leading to faster (priming) or slower (interference) responses to stimuli presented in different parts of space (e.g., Estes, Verges, & Barsalou, 2008; Richardson et al., 2003; Zwaan, Yaxley, 2003). A similar effect accompanies access to emotionally valenced words: the processing of "positive" words (e.g., happiness) orients attention upwards and the processing of "negative" words (e.g., disaster) — downwards, suggesting grounding of emotions in spatial cognition, among others (e.g., Gozli, Chasteen, & Pratt, 2013). It remains unknown, however, to which degree (if at all) such grounding may take place in non-native language.

In the present study, we explored embodied word access in bilingual speakers. Following a well-documented Foreign Language Effect (Keysar et al., 2012), characterized by more rational decisions made in L2 than in L1, our main hypothesis was that while accessing both L1 and L2 words could be associated with the spatial-conceptual biases, these biases should be stronger in L1. Russian-English bilinguals read emotionally valenced words (positive, negative, neutral) in L1 or L2 before detecting and categorizing a visual probe (square/circle) presented in upward, downward, or central screen locations. In addition, we assessed participants' L2 proficiency with the help of the short version of the Cambridge English test.

Our analysis revealed a reliable main effect of Language (F = 14.363, p < .0005) — participants were faster to perform the task after reading words in L1 than in L2. More importantly, we also registered a reliable Language x Congruency interaction (F = 3.612, p < .05): participants were faster to perform on the main probe detection task in congruent than in incongruent conditions only in L1. The dynamics show that while in L1 incongruent probes are detected faster (possibly due to sensorimotor interference by way of perceptual simulation), in L2 the faster reaction times are observed in the congruent condition (possibly due to facilitation by way of orienting of attention to the location compatible with the conceptual representation). A multiple linear regression analysis shows effects of language, reaction times for L2 being significantly slower (t = -2.119, p = .03), congruency, incongruent condition slowing down the reactions (t = -1.963, p = .04), as well as an interaction between congruency, probe language and L2 proficiency.

In general, our data support our main hypothesis suggesting a different depth of embodied processing in L1 and L2. We conclude that L2 emotionally valenced words are accompanied by sensorimotor activation. At the same time, this activation is much faster for L1 words, in line with the view of a lesser degree of automaticity in L2 processing.

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Dynamics of mental representations of novel concrete and abstract concepts modulated by learning context and transcranial direct current stimulation

To date, little is known about flexibility of conceptual representations and whether it can be modulated naturally or artificially. Moreover, distinctions between mental representations of concrete and abstract concepts as well as their neural underpinnings are still debated (Jamrozik et al., 2016; Borghi et al., 2017; Montefinese, 2019). The present study aimed to investigate 1) the dynamic features of concrete and abstract concepts, 2) effects of transcranial direct current stimulation (tDCS) over Wernicke's area on the quality of acquisition and activation of new concepts.

Three groups (16 native Russian speakers each, mean age — 21 y.o.) received cathodal, anodal or sham tDCS over Wernicke's area and then performed the task of contextual learning of novel concrete and abstract concepts, embedded in short visually presented stories. After an overnight sleep, the participants were presented with a modified version of the same learning task, aimed at (1) reinforcing new representations through repetition (Repetition condition), (2) modifying them by

providing additional contextual details (Generalization or Specification), or (3) degrading them through inconsistent contexts (Destruction). The acquisition outcomes were assessed on both experimental days using Free Recall, Recognition, Free Definition and Cued Definition Choice tasks.

The Free Recall task showed that Destruction manipulation decreased ($p < .05$) the efficacy of word-form reactivation (mean recall rate = 40.1%) while Repetition enhanced it the most (55%). Further, in the Cued Definition Choice task, Destruction condition produced lowest accuracy (m = 35.1%), while Specification led to significantly higher ($p < .05$) accuracy than Generalization (70.4 vs. 56.4%). These results indicate that context is a powerful tool to control mental representations of concepts at both lexical and semantic levels.

The results of the Free Definition and the Cued Definition Choice tasks confirmed the well-known "concreteness effect" (Paivio, 1965): concrete items were defined with significantly higher accuracy than abstract ones (63 vs. 51%; $p < .05$).

Finally, we found that cathodal stimulation of Wernicke's area leads to significantly faster reactions ($p < .01$) and significant increase of accuracy ($p < .01$) in the Recognition task both on the first and second days of the experiment. Thus, tDCS can be considered a neuromodulation technique capable of affecting the quality of concepts acquisition and retrieval.

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Lexical ambiguity in slogans: Does it make a polycode text easier to recognize?

An advertisement poster is a polycode text, consisting of verbal and non-verbal elements. Its perception is integrative (Anisimova, 2003) and starts with the processing of a non-verbal part (Wedel, Pieters, 2000; Obermiller, Sawyer, 2011). However, there are studies indicating that

people spend more time processing the text than the picture (Rayner et al., 2001). Our hypothesis is that the ambiguity contained in a slogan affects the process of recognition of advertisements. The purpose of the study was to compare the processing of ambiguous and unambiguous advertising posters. We tried to answer two questions: a) are ambiguous posters recognized better than ads without ambiguity; b) what part of a polycode poster is recognized better (verbal or non-verbal)?

We used 14 ads with ambiguous slogans (one meaning supported by the picture, the second one — by the advertising text), 14 unambiguous ads (the same meaning contained in the picture and the text), 7 fillers. All the posters were equalized by the size, font, color and the layout of the elements.

Participants: native speakers of Russian (N = 71, female = 48, male = 23, SD = 11.4).

The study consisted of two parts. First, participants indicated their appreciation for the stimuli. The mean scores of the six five-point scales were calculated. 3–4 weeks later the participants were presented the "halves" of the posters (pictures or verbal parts) and asked to recall whether they had seen this poster in the first stage of the experiment.

The results show that ambiguous ads are recognized better than unambiguous ones, regardless of which "half" of the poster was presented to the participants ($\chi^2 = 18.35$, p < .001). Verbal parts of the ads are recognized better than non-verbal ones ($\chi^2 = 6.095$, p = .014) only in ambiguous posters. There are no significant differences in better recognition for pictures and text parts of unambiguous posters.

Overall, these results indicate that ambiguity of a slogan affects the memorability of a poster: both text and picture parts of the posters with ambiguity are recognized better than text and picture parts of unambiguous posters. We suppose that the ambiguity of a slogan makes the information processing more resource-intensive and hence leads to better delayed recognition of the advertisements.

FLASH TALKS SESSION 2

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Development of novel word acquisition paradigm for non-invasive brain stimulation studies

Studies using non-invasive brain stimulation applied to healthy human participants frequently have null results. The reason may be ceiling effects due to insufficient difficulty of an experimental paradigm, rather than the inefficiency of stimulation (Antonenko et al., 2016; Malyutina et al., 2018; Pozdnyakov, 2018). Consequently, effects of non-invasive brain stimulation can be revealed via more challenging tasks, such as a word learning task in the linguistic domain. This paper aims to develop a word learning paradigm sensitive to potential effects of non-invasive brain stimulation. To do so, we have chosen word learning tasks and materials challenging even for healthy participants and validated their difficulty level in a pilot experiment. The paradigm was tailored to brain stimulation parameters commonly used in previous studies: duration of 20 minutes, and measuring performance both during and after stimulation.

We prepared stimuli lists of 80 pseudowords based on our previous study (Stupina, Chrabaszcz, 2020). We paired pseudowords with 80 semantically unrelated inanimate Russian nouns from the database (Akinina et al., 2014) based on their semantic similarity, length, and gender. We have also developed an explicit word learning paradigm consisting of two phases. The acquisition phase includes passive acquisition, three-alternative-forced choice and recall tasks. The testing phase includes recognition, recall and semantic decision tasks.

We conducted a pilot online experiment to validate the difficulty level of the paradigm. In the testing phase, participants performed reasonably well in recognition (accuracy: M = 71%, SD = 15%, range 50 — 90%) and semantic decision (accuracy: M = 75%, SD = 10%, range 60 — 95%) but not in the recall task (accuracy: M = 17%, SD = 13%, range 0 — 35%). In addition, participants reported a lack of time in the recall task but not in other tasks.

Thus, the paradigm provides a variety of task difficulty levels, with no floor or ceiling effects, and should be sensitive to improvement of performance by brain stimulation. The only change we made to the paradigm based on online validation was extending the response time in the recall task to 10 seconds. The paradigm has proven suitable for brain stimulation experiments and other studies on novel word acquisition.

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Implicit Prosody Hypothesis in reading:
Talker-to-listener distance effect in intonation contour

Prosody research provides accumulated evidence that implicit prosody can influence online sentence interpretation. The Implicit Prosody Hypothesis (IPH) suggests that, in reading, a default prosodic contour is projected onto the read phrase not as a translation of written material into acoustic form but rather priming the listeners` interpretation of the message (Fodor, 2002; Breen, 2014).

Intonation contours (ICs) specify the semantic content of utterances producing discourse units with different communication messages (Pierrehumbert, Hirschberg, 1990), and, being directed by the listeners` needs, choices of ICs should be constrained to specific structures and variations of their constituents (Cutler, 1987; Xu, 2011, 2015). We suggest that talker-to-listener distance (TLD) effect in reading is created by variations of F_0, intensity and internuclei duration.

Two samples of utterances with the same syntactic structure (canonical imperative sentence (Aikhenvald, 2010)) but different communicative functions were compiled. The first sample (373 utterances) included read-aloud "calling from the distance" utterances, the second (373 utterances) — typical imperative utterances. Both samples underwent the acoustic analysis and the results were examined with statistic tools.

In agreement with previous research of TLD (Brungart et al., 2002; Cheyne et al., 2009; Fux et al., 2011), the two samples show significant difference in intensity range (t-statistics 7.80 with t critical two-tail 1.96, p ≤ .001), Q2 of intensity (t-statistics 8.43 with t critical two-tail 1.96, p ≤ .001), both parameters bigger in the first sample (mean intensity range — 53.1 and 44.8 dB, median intensity range — 52 and 44.9 dB with standard deviation accordingly 16.3 and 12.5; mean value of Q2 of intensity — 67 and 62.8 dB and median value of Q2 of intensity — 67.6 and 63.2 dB). We also found greater internuclei duration (mean value of internuclei duration — 0.51 and 0.44 msec, median value of internuclei duration — 0.47 and 0.4 msec) and little significant F_0 down- or up-shifting in the first sample (t-statistics -3.41 with t critical two-tail 1.96, p ≤ .001). In 58,4% of utterances there is no significant tonal movement identified by the analysis; mean F_0 variation in semitones is 15.3 compared to 17 in the second sample, median value of F_0 variation in semitones is 14 compared to 16.5, Q3 of F_0 variation is 19 semitones to 21.4 in the second sample.

As we are looking at imitated shouted speech, F_0 stylized trajectory in ICs of the first sample shows less tone variation, which disagrees with findings by Fux et al. (2011), but can be explained by the character of samples: "calling from the distance" ICs in reading do not mark the actual distance between the co-communicants, but rather create an impression of it. Being accompanied by greater internuclei duration, it supports Brungart et al. (2002) finding that TLD effect can be influenced by non-pitch

features: the utterances seemed to be prolonged as if they are coming from greater distance than they actually are. At the same time, they appear to have less variable tone structure which adds to the impression of gradually decreasing faraway shouted speech.

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Grammatical roles assignment in Russian-speaking children

Previous studies (Slobin et al., 1982) have shown that in simple sentences children until the age of 4 are more likely to assign the role of subject to the first noun regardless of its case. We hypothesized that 3-to-4 years old children in our study would also rely on word order and make less errors while assigning subject and object roles in sentences with direct word order (SVO) than in sentences with inverted word order (OVS). We also expected that in sentences with 3 arguments, with third argument being either in prepositional or instrumental case, instrumental argument would provoke more errors in children until the age of 6, because Russian instrumental case is acquired later than prepositional one (Polinsky, 2006).

148 children aged from 3 to 7 completed sentence comprehension and sentence production tasks presented on a tablet. In sentence comprehension task, participants had to match one of the two pictures to the auditorily presented stimulus sentence (N = 24). In sentence production task, participants had to describe pictures similarly to what they had to do in auditorily presented stimulus sentence (N = 24). Stimuli sentences varied in word order, number of arguments and the case of the third argument. Answers in the comprehension task were automatically coded; answers in the production task were audio-recorded and coded by a linguist.

Our hypothesis that 3-to-4 year old children would make more errors in OVS sentences was not confirmed: after computing generalized linear mixed-effects model we found no difference in accuracy between SVO and

OVS sentences across all ages (p > .1). Second hypothesis was not confirmed as well: sentences with a third argument provoked more errors (sentence comprehension task: Est. = -.784, SE = .436, p < .1; sentence production task: Est. = -2.432. SE = 0.346, p < .001), but there was no difference in accuracy depending on the third argument's case (p > .1).

This study demonstrated that Russian-speaking children use morphological cues for grammatical roles assignment already at the age of 3. Children make more errors in the 3 argument sentences regardless of the third argument case. It might be explained by the fact that semantics of locational prepositions used in our tasks may be not fully acquired before the age of 7 (Leikin, 1998; Polinsky, 2006).

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Does metacognitive regulation of emotions contribute to the understanding of ambiguous texts?

Emotions play an important role in solving various cognitive tasks: they can improve cognitive processes (Afzali, 2013) and guide readers in developing a coherent representation of the situation described in the text (Van Dijk, Kintsch, 1983). Previously, the intensity of emotions was found to be linked to reading comprehension (Daley at al., 2014); hence, emotions can be important in understanding ambiguous texts such as fables (Moiseyeva, 2017). Understanding of these texts requires both developed conceptual thinking and systems of cognitive and affective regulations. This implies that metacognitive regulation of emotions contributes to the process of understanding fables' gists.

Seventy volunteers participated in our study. We used in-depth semi-structured interview based on nine Aesop's fables (3 sets, 3 fables each). The task was to interpret each fable and formulate its gist. Interpretation of each fable was scored 0, 1 or 2 depending on whether it was concrete or generalized (Shcherbakova, Nikiforova, 2018). The interviews were audio-recorded and then transcribed verbatim. Additionally, participants

were administered several questionnaires and tests: "Cognitive Regulation of Emotions Questionnaire" (CERQ) (translated and adapted by O.L. Pisareva, A. Gritsenko), 2010; "Raven's Standard Progressive Matrices Test" (SPMT), 2000; "Questionnaire of Emotional Intelligence" (EmIn) by D.V. Lyusin, 2009; "Reading the Mind in the Eyes" (adapted into Russian by E.E. Rumyantseva), 2016. Participants were tested individually. Each session lasted up to two hours.

Regression analysis did not show any significant contribution of affective processes to understanding of fables. However, we found that IQ contributes to the depth of fables understanding and explains 12% of the variance. Factor analysis supported these findings by revealing 3 factors: "Affective Sphere", "Theory of Mind", and the factor combining both the depth of fables' understanding and IQ. These results suggest much lower correlation between understanding of ambiguous texts, EQ, metacognitive regulation of emotions, and Theory of Mind than was expected, while IQ seems to be the closest psychological construct out of three to texts' understanding.

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Digital or printed? Interaction between text format and its understanding

Nowadays, as the intensity of digitalization processes that affect many everyday cognitive practices increases, researchers become more and more interested in related changes in information processing. Particularly, many of them focus on how reading efficiency is affected by massive Internet use and working with hypertexts which are known to provide extra cognitive load on the reader (Kerr et al., 2006). Some recent data show that the level of understanding of a text depends not only on complexity of the information itself but also on physical properties of its carrier (Morineau et al., 2005).

We hypothesized that there may be a relation between the level of the understanding of a text and the format of its presentation (printed or digital). Namely, we expected a lower level of understanding for digitally presented text compared to its hard copy printed analogue due to higher cognitive 'cost' of reading in a digital environment. We also expected that the use of extra materials (EM) providing additional information to the main text is related to the form of text's presentation: EM accompanying printed text will be used more often than those available through hyperlinks in the digital environment.

40 volunteers (31 females, mean age = 19.5 ± 0.5 years) participated in our study. Participants were randomly assigned into two groups: control group (administered with a stimulus text in printed format) and experimental group (administered with the same text in digital format). The task was to read the text and then answer several questions (presented in written form) aimed at assessing the level of text understanding. Following that, we conducted a semi-structured interview to assess the amount of cognitive efforts invested by each participant into understanding the two different versions of the text. Additionally, we used Raven's Standard Progressive Matrices (SPM) to control the level of general cognitive ability. All participants were tested individually. The interviews were audio-recorded and then transcribed verbatim.

To test the first prediction, we compared the groups by the number of mistakes they made when answering written questions about the content of the text (using Student's t-test) and the level of understanding based on interview assessments by experts (using Mann–Whitney U-test). None of the tests revealed statistically significant differences ($ps > .05$). To test the second prediction, we compared the groups on the amount of usage of EM using (with Mann–Whitney U-test). The obtained results show that participants used EM more often ($p < .05$) when the text was presented in printed format compared to the condition under which it was presented digitally, which provides some support for our initial hypothesis.

To sum up, the level of understanding of the text was not affected by the format of its presentation, which is not consistent with previously reported findings (Kerr et al., 2006; Mangen, 2008). Whereas the higher frequency of using EM for printed texts might be an indicator of higher cognitive

'cost' of reading digital text. Further research with additional conditions is needed to validate and extend the present results.

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How do Spanish natives and Spanish learners resolve pronominal anaphora?

In pro-drop languages, null subject pronouns tend to be co-referred with their subject antecedents in case of referential conflict (Carminati, 2002). The present study aims to answer the question whether Spanish native speakers and Spanish learners with Russian L1 resolve pronominal anaphora in line with that strategy. Anaphora resolution is understudied on this language pair, which in turn combines a full null-subject language (Spanish) and a semi null-subject language (Russian).

The experimental group of Spanish L2 learners with Russian L1 (N = 42) was compared to the control group of Spanish L1 speakers from Latin American countries (N = 90). All participants performed a self-paced reading experiment, namely, reading pairs of sentences word-by-word. The first sentence introduced two animate constituents of the same gender (Subject and Object), whereas the second sentence started with a third person Singular pronoun (null or overt) referring to one of those constituents. We expected to see a speedup in reading time on either of the pronouns which would imply the existing null-subject bias in pronoun resolution.

The analysis of residual reading times with a linear mixed-effect model (performed in R, Version 4.0.0) revealed no significant effects of the antecedent syntactic role, pronoun form or their interaction in Spanish L2 learners (p = .8).

However, a significant interaction between the antecedent syntactic role and pronoun form was found in Spanish L1 speakers (p < .001),

indicating that they read overt subject pronouns co-referred with the subject antecedents faster than other conditions.

We observed a difference in the strategies applied by native speakers and Spanish L2 learners in pronominal anaphora resolution. Spanish natives indeed co-referred a pronoun form with a syntactic role of the antecedent, whereas Spanish learners did not. The results demonstrated by Spanish native speakers are compatible with those showed by Italian natives (Carminati, 2002) and by native speakers of Mexican Spanish (Keating et al., 2011). At the same time, the results demonstrated by Spanish learners with Russian L1 resemble the ones by English-Spanish heritage speakers and L2 learners (Keating et al., 2011).

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Speech dysfunction with damage of the subcortical structures of the brain as a result of the ischemic stroke

In patients who have experienced ischemic stroke localized in the subcortical brain structures, symptoms that are not typical for lesions of these areas are often observed (Moretti, Caruso, & Crisman, 2018). That is due to the close location of many highly specialized structures, and numerous cortical-subcortical connections as well (Fuertinger, Horwitz, & Simonyan, 2015). Thus, a primary analysis of non-aphasic speech dysfunctions developing as a result of such damages is conducted.

The sample included 17 patients diagnosed with ischemic stroke. The abnormal focus was localized in subcortical brain structures. Research methods: Montreal Cognitive Assessment (MoCA) (Nasreddine, Phillips, & Bedirian, 2005), "10 words" technique (Akhutina, 2012), observation, qualitative analysis, neuroimaging, Spearman's correlation coefficient.

The subscales of MoCA showed the following: "Naming" — 1 out of 3 points in 88% of the participants; "Phrase repetition" — 0 out of 2 points for 100% of the participants; "Speech fluency" — 0 out of 1 point in 76% of the participants. The mean score for "10 words" technique was 3.6. We also

identified a relation between the parameters "Speech functions" and "Memory" (Spearman's R = 0.5921; p = .0122). Qualitative analysis of the results obtained by the "Naming" subscale of MoCA revealed difficulties in choosing the correct word when describing pictures. Qualitative analysis of the results obtained by the "Speech" subscale of MoCA revealed difficulties in choosing necessary words and showed that patients could not fully reproduce the sentence proposed for repetition and also struggled with starting a sentence.

The described features can be interpreted in the following way: difficulties in naming objects, choosing right words, and starting a sentence are associated with the impaired ability to extract the necessary concepts from semantic long-term memory. The main reason for this could be impaired connections between subcortical structures and parietal-temporal-occipital zones. In addition, the difficulties in constructing sentences are associated with the separation of the subcortical structures from the frontal areas which normally provide regulatory effect.

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The cognitive processing of the grammatical gender of Russian nouns by Russian natives and Turkic-and-Russian bilinguals

The study develops the bilingualism research in linguistics (A.A. Zalevskaya, T. Love, J. Mueller, etc.). It is connected with international communication and total bilingualism as well as grammatical system of the languages which is essential because natives do not consciously think of the grammar producing the speech (E. Bialystok, J.F. Kroll, E. Andonova, E. Bates, Z.I. Rezanova, etc.). The research on grammatical gender is one of the most popular among bilingual studies. However, the Russian and the Siberian Turkic languages have not been studied regarding this aspect although the grammatical interaction between those languages might reveal many peculiarities as Russian has three grammatical genders and Turkic languages do not have a grammatical gender system. The main purpose

of the study is to analyze the influence of the prime (male or female) and social stereotype which might be contained in semantics (regarding to a preliminary study) on the cognitive processing of gender opposed words in Russian. Another purpose is to find out whether the analyzed influence is universal or it interacts with the bilingualism factor.

In order to achieve our goals we used the behavioural experiment paradigm and measured the reaction times in a lexical decision task. The participants were 44 Russian natives and 31 Turkic-Russian bilinguals. We used 4 independent variables: type of grammatical markers (masculine, feminine, neutral); type of picture priming (male or female); sphere of use (male or female); native language (Russian or one of the Turkic ones).

The results indicated the following: first, the factor of the grammatical marker is important for the natives ($p = .02$) but not for the bilinguals ($p > .05$); second, the female sphere is processed faster than the masculine sphere by both groups of participants ($p < .00/p = .01$); third, there was no interaction between linguistic and social factors in the groups of natives, however, such interaction was found in the group of bilinguals.

The results of the study show that there are certain factors which affect the processing of the grammatical category of gender but they have different values for native speakers of Russian and Turkic-Russian bilinguals. Priming image affected only the group of bilingual respondents. The reason is that priming activates a reference connection which native speakers of a Turkic language build for themselves when studying Russian. We assume that this connection is also present in Russian speakers, but priming cannot affect it.

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Oscillatory brain activity during selective word retrieval in healthy adults

Selective word retrieval is core to fluent language production. This ability bases on two different processes: search for options and alternatives

selection. To detail spatiotemporal cortical activity which underpins the process of alternatives selection, we compare two types of word retrieval with the different needs to use rules.

Fifteen healthy right-handed adults (one male, mean age = 24) participated in the study. Each subject was examined five times and was administered both verbal tasks during one session. The first task was to construct nouns (n = 9) from 6-letter sets. The second task (n = 9) was to find a three-letter noun that would end the first six-letter word and start the second six-letter word. For example, ADV (...) MAN. In other words, the participant had first to construct six-letter noun and then to check if it agrees with the rule. If not, the participant had to create alternative six-letter noun. 40 seconds were given for each single trial. 19-channel EEG (0.53–30 Hz) was recorded during task solving. EEG spectral power was calculated in five bands: theta (4–7.5 Hz), alpha1 (7.5–9.5 Hz), alpha2 (9.5–12.5 Hz), beta1 (12.5–18 Hz) and beta2 (18–30 Hz). The spectral power was averaged for each person in four conditions: before and after the answer, in no-answer trials, and in the control series, and then was compared between the tasks using the Friedman's test.

EEG spectral power in control conditions and after the answer did not differ between two tasks. However, in no-answer trials, beta1 spectral power in T5, T6, and O2 sites was significantly higher in case if participants had to use the rule for finding a word. The tendency to between-task differences in beta1 power in T5 and T6 sites was also obtained in before-the-answer condition (corrected p = .108 and .063). Moreover, in before-the-answer condition, spectral power of beta2 EEG band in T6 was higher (p = .023) during selective word retrieval.

It was found that oscillatory activity in beta EEG band in posterior temporal regions underlay the selective word retrieval in healthy adults. This data supports the hypothesis about pMTG and pSTG special role in word selection process.

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Russian words for speech audiometry in children

The assessment of speech intelligibility by the method of speech audiometry in children is possible from the age of four, and sometimes even earlier. One of the crucial requirements for speech audiometry in children is that all words in the word lists should be familiar to children. Until now, when assessing hearing in children, lists of two- and three-syllable words were used (Osherovich, 1965). We argue that using monosyllabic words should increase the accuracy of speech audiometry, as monosyllabic words have less information redundancy. In this paper, we introduce new monosyllabic word lists for Russian speech audiometry in children.

To compile the word lists, we selected frequent monosyllabic nouns from the New Frequency Dictionary of the Modern Russian Language by O.N. Lyashevskaya and S.A. Sharov. The words were compared with speech therapy word lists (lexical minimums) and teaching aids for children of the target age group (3–7 years old). We also presented these words to 40 children without hearing impairments and asked them to explain the meaning of the words. Only the words that were familiar to at least 85 percent of children were included in the final word lists.

Ten lists of monosyllabic nouns, ten words in each, were compiled so that each list contained as many different Russian phonemes as possible. To perform speech audiometry, we recorded the word lists read by a male speaker. When checking the perceptual balance of the word lists, each of them was presented to 30 children of three age groups (5–6, 7–8 and 9–10 years old) with normal hearing under equivalent test conditions (in headphones, with monaural presentation of speech material to the dominant ear). We calculated the percentage of correct answers given by each participant for each word list. Then we revised seven word lists where the average percentage of correct answers was lower than 80 percent. In total, we substituted 16 words from these lists that caused the greatest number of errors (*mak* 'poppy', *luk* 'onion', *bant* 'bow', etc.). We also moved some words from one list to another to maintain the balance of sounds in different lists.

After that, a new audio recording of the speech material was performed. Its subsequent testing confirmed the perceptual balance of the new word lists: the average percentage of correct answers for each of the word lists was higher than 92 percent. The word lists are currently used in clinical practice.

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Neurophysiological features of brain stages of visual verbal information processing under the conditions of target mental activity

It is known that the verbal material processing includes several stages. The early stage contains sensory processing of the stimulus and early lexical access (Strijkers et al., 2010; Logvinenko et al., 2019). Later stages include lexical-semantic analysis (Vartiainen et al., 2009) and cognitive processes such as prediction, extracting information from episodic memory resources (Stróżak et al., 2016; Mecklinger et al., 2016; Althen et al., 2020). The aim of this study was to compare the brain stages of visual verbal information processing under the conditions of target mental activity during semantic categorization and under the conditions of passive reading.

Twenty-five students of natural science profile aged from 19 to 25 years were the participants of the experiment. Combinations of an adjective and a noun were presented as a stimulus material. The subjects' task was to categorize phrases by the first word (adjective) in the first series of presentations and to categorize phrases by the second word (noun) in the second series by pressing a certain key, depending on the condition. Each word was presented for 1200 ms with an interstimulus interval of 200 ms. We analyzed the components of event-related potentials (ERPs) in response to the presentations of adjectives and nouns in target and non-target conditions.

We found that target nouns elicited larger amplitudes of components with a latency around 200 ms after the stimulus onset (P200) in the central

and parietal leads (e.g., differences for the left central lead (C3) in 96–221 ms interval, p < .0078). Also, it was observed that target nouns elicited smaller amplitudes of the negative waves with a latency of 300–400 ms (N400) in the central and parietal leads (e.g., differences for the right parietal lead (P4) in 247–381 ms interval, p < 0.0028) and larger amplitudes of the late negative waves in the central, parietal and temporo-parietal leads (e.g., differences for the left temporo-parietal lead (T5) in 732–943 ms interval, p < .0002). We observed only focal changes in the late positive component around 600 ms after stimulus onset in the parietal region for adjectives (differences for the central parietal lead (Pz) in 488–555 ms interval, p < .0280).

Thus, ERPs in response to the nouns presentations were sensitive to target and non-target conditions in both early and late stages. The adjectives did not show high sensitivity to changes under these presentation conditions.

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Word length and frequency effects on eye movement parameters in elementary school children reading textbooks

We aimed to estimate how word frequency and word length impact reading speed and fixation parameters in Russian primary school children.

53 students from grades 1–3 from Moscow secondary schools took part. They had to read aloud as fast as they could 7 narrative and descriptive texts (23–52 words, from reading textbooks for grades 2–3) and after each text answer a question on general comprehension to avoid mindless reading. Texts varied and were counterbalanced in average word length and frequency. An SR Research Eyelink 1000+ eye-tracking system was used for eye movement recording.

Reading speed was significantly affected by the grade (p < .0001) and particular text (p < .0001). Fixation length decreased from grade 1 to 3. The proportion of fixations on a given word and the relative gaze dwell time

were highly linearly related (r = 0,985, p < .001) and the percentage of time spent for reading each word remained the same.

Improvement in reading skill was also marked by the drop in a number of fixations per word or per symbol (p < .0001). This reflected the switch from sublexical to lexical strategy. Word frequency rank, word length rank, grade were significant factors for average fixation length (all ps < .01). We standardized fixation data to remove individual effects; then word frequency rank significantly impacted fixation duration, but word length did not (p < .0001, p < .26, respectively).

Word frequency effect was confirmed for the students of all skills categories, as longer fixations were made on rare words. Growing reading skills and transition from sublexical to lexical strategy are reflected in all eye movement parameters. Not all readability formulas account for word frequency, but it can explain low reading speed of a text which was not marked as difficult by word length parameters and standard readability formula. Moreover, some relatively frequent words are unfamiliar to children and can pose a challenge; "word familiarity" is an important factor for text accessibility prediction. Our analysis used word frequency data from the Russian National Corpus which does not perfectly reflect word frequency distribution in texts aimed for children.

Our results confirm the power of word frequency effects for children learning to read and provide evidence that the information about word frequency is helpful in the readability assessment of Russian educational texts for elementary school.

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Perception of irony in speech

This study deals with the comparison of the expression and perception of irony in Russian male and female speech. Irony is understood as the negation of lexical sense by means of intonation. We consider how well

the irony can be perceived in speech of both gender groups with no grammatical, syntactic or lexical markers of it, as well as without the large semantic context.

We composed 86 short texts and dialogues, in which the same target words, groups of words or phrases were put in various ironic and non-ironic contexts. Two male and two female Russian native speakers read them in a sound booth. 45 target fragments were then extracted from the recordings of each gender group and presented to the listeners in two separate auditory perception experiments. The listeners were asked to associate the fragment to the context from which it had been extracted. 112 listeners participated in the experiment with male voices and 50 listeners in the experiment with female voices.

The statistical analysis proved that listeners are able to recognize ironic utterances relying on their phonetic characteristics and not on the context or marker. 77.2% of listeners correctly detected ironic utterances in female speech and 69.4% in male speech, i.e. the female speakers better expressed irony by prosodic means only. Both male and female speakers used the technique of the "prosodic hyperbole" for irony expression: the stressed vowel in the ironic utterances was longer (the mean difference was about 55 ms in male speech and 35 ms in female speech) and the mean intensity level of the phrase was higher (the mean difference was about 7.8 Db in male speech and 1.8Db in female speech) than in the non-ironic utterances. Although the stressed vowel lengthening and the increase in intensity were more obvious in ironic speech of male speakers, the combination of these acoustic cues with the widening of F0 range could provide a better recognition of irony in speech of female speakers.

The results of the experiment showed that the detection of acoustic cues of irony is an attainable goal. Its achievement is important not only for systems of artificial intelligence, but primarily for a better understanding of the processes of generation and perception of speech. At the same time, further research is needed to explain the fact of a more successful detection of irony in women's speech.

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Does sound determine synesthetic color? Evidence from Russian

Grapheme-color synesthesia is a condition in which graphemes are colored in a specific way in a person's mind. The influence of the sound that corresponds to each grapheme on the color perceived by a synesthete was shown to be low in English language (Simner, 2007) and considerable in Japanese (Asano, Yokosawa, 2011) and Korean (Shin, Kim, 2014). Our study aims at examining whether the pronunciation influences the perception of Cyrillic graphemes by Russian-speaking synesthetes.

We asked 15 participants (17 to 50 y.o., 13 women) who successfully passed the Synesthesia Battery test (synesthete.org), i.e. were shown to be grapheme-color synesthetes, to choose the colors that, in their opinion, correspond to certain Russian two-letter combinations. In the first experiment, the stimuli included the graphemes that can be pronounced in Russian as either voiced or voiceless consonants depending on their position. The stimuli of the second experiment were two-letter vowel + consonant combinations that are pronounced identically in the Russian language. We hypothesized that the geometrical distance in the color space RGB between the colors chosen by the participants would be shorter when the pronunciation of the two-letter combinations is the same (e.g. *иб* and *ип* both pronounced as [ip] or *ши* and *шы* both pronounced as [ʃi]) than when the pronunciation is different (e.g. *би* [bʲi] / *пи* [pʲi] and *иш* [iʃ] / *ыш* [iʃ]).

The ANOVA showed the influence of the sound in the first experiment (p = .005). The influence of the variable "participant" was found in both experiments (ps < .001). We used the Student's t-test to compare every participant's color values for separate letter combinations. The sound was shown to be a significant factor for some participants of the first experiment (p ≤ .03) and for *other* participants of the second experiment (p ≤ .04).

The results of the first experiment support the hypothesis that the sound can influence the choice of the color in grapheme-color synesthesia. Thus, we suppose that it is more crucial for consonants than for vowels in the

Russian language. As the participants for whom the sound was significant in the first experiment were not the same as those for whom the sound played a part in the second experiment, we can assume that the influence of the sound for Russian speaking grapheme-color synesthetes is selective, i.e. emerges on different grapheme combinations for different participants.

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The neuropsychological assessment of verbal memory in preschoolers and primary schoolchildren

The role of verbal memory in mastering the school curriculum is well known (Stipek, Valentino, 2015). This makes it important to assess this function and its relevance to other cognitive components. In our work, we analyzed the results of verbal memory task in children 6–9 years old and tried to identify and compare groups with different features of the task performance.

In total, 370 children participated in the study (97 preschoolers; 91 1st graders; 116 2nd graders; 66 3rd graders). All children underwent a full traditional neuropsychological assessment and a computer test battery. In this study, we examined the results of a verbal memory task "Repetition and Memorization of two groups of three words".

We distinguished 6 groups of children with different profiles of productivity (Pr) in the verbal memory test.

1) Children (n = 178) with high Pr (increase in Pr from the 1st to the 2nd trial, total Pr at least 11 words out of 18);
2) Children (n = 32) with a sharp increase in Pr from the 1st to the 2nd trial by more than 3 words;
3) Children (n = 33) with "flat" Pr (the Pr of the 1st-2nd trial is equal, the total Pr is more than 9);
4) Children (n = 38) with a decrease in Pr compared to previous trials;
5) Children (n = 38) with reduced Pr (increase in Pr from 1st to 2nd trial, total Pr is between 9 and 10.5 words);

6) Children (n = 50) with low Pr (total Pr is less than 9 words).

We analyzed the neuropsychological profiles of children from these 6 groups. In children of group 1, the indices of all functions were above average (from -.11 to -.33). Group 2 had similar indices, with the exception of the right hemispheric function index +.11. Children of the 3rd group differed in the low state of functions of the 1st block (+.19). Children of the 4th group had the worst auditory information processing index (+.17). Almost all functions except motor functions were deficient in children of group 5 (from .15 to .47 — functions of the right hemisphere). Weakness of all functions was characteristic of children in group 6 (from .14 to 1.11 — functions of the left hemisphere).

The same results were obtained using computer neuropsychological tests. We found significant differences between the children of 6 groups not only in the auditory processing test (p = .014 in ANOVA), but also in the tests for executive functions (The Dots, p < .001; Schulte tables, p < .001) and in Raven's Matrices (p < .001) and Understanding of Grammatical Constructions (p < .001).

The results of this study, firstly, confirm the idea of participation of many mental components in verbal memory (Ardila, Rosselli, 1994; Jonides et al., 2008) and, secondly, show the possibility of using computer tests for neuropsychological differentiating of groups of children.